

Claims

1. An optical reading device having a light source, a
movable optical waveguide, an actuator, a detector, and
5 wherein the actuator and detector are integrally formed
in a substrate, the movement of the waveguide being
effected by action of the actuator thereon, and wherein
the detector provides a confocal detection system
adapted to effect a detection of light backscattered
10 into cladding of the waveguide.
2. The device as claimed in claim 1 further including at
least one motion sensor such that any movement of the
waveguide is detectable by the motion sensors.
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3. The device as claimed in any preceding claim wherein
the optical waveguide is formed as an integrated
channel guide formed in dielectric materials and
surrounded by a cladding of restricted lateral
20 dimensions.
4. The device as claimed in claim 1 or claim 2 wherein the
waveguide may be externally attached or coupled to the
device.
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5. The device as claimed in any preceding claim wherein
the optical waveguide is single-moded and polarization-
preserving.
- 30 6. The device as claimed in any preceding claim wherein
the source is polarized and arranged to excite a single
polarization mode of the waveguide.

7. The device as claimed in any preceding claim wherein the optical waveguide is positioned on a suspended cantilever above a substrate.
- 5 8. The device as claimed in claim 7 wherein the waveguide is supported by a mechanical layer along its entire length.
9. The device as claimed in claim 7 wherein the waveguide
10 is supported only near its root by a mechanical layer.
10. The device as claimed in any preceding claim wherein the actuator and detector are integrally formed in a silicon based layer.
- 15 11. The device as claimed in claim 10 wherein the detector is constructed in the silicon layer as a p-n junction or p-i-n junction photodiode.
- 20 12. The device as claimed in any preceding claim wherein the detector is placed beneath the waveguide to detect cladding modes present in the waveguide.
13. The device as claimed in claim 7 wherein the detector
25 is a photodetector and is placed or formed at the tip of the cantilever.
14. The device as claimed in claim 7 wherein the photodetector is placed near the root of the
30 cantilever.
15. The device as claimed in claim 7 wherein the actuator is placed near the root of the cantilever.

16. The device as claimed in claim 15 wherein the actuator is constructed as an electrothermal or electrostatic drive.
- 5 17. The device as claimed in claim 16 wherein the actuator is an electrothermal shape bimorph actuator.
- 10 18. The device as claimed in claim 17 wherein the waveguide is placed over a cold arm of the electrothermal shape bimorph actuator.
- 15 19. The device as claimed in claim 16 wherein the electrothermal shape bimorph actuator has dual hot arms.
- 20 20. The device as claimed in claim 18 wherein electrical current in the cold arm is monitored and suppressed using an active feedback circuit.
21. The device as claimed in claim 17 wherein the motion sensors are placed near the root of the cold arm and the root of the cantilever.
- 25 22. The device as claimed in claim 21 wherein the motion sensors are constructed as pairs of piezo-resistors, arranged to detect differential strain caused by bending of the structure and connected to a differential readout circuit.
- 30 23. An optical reading system comprising a device having one or more of the following components:

- 5 a) a cantilevered single-mode optical waveguide
suitable for transmitting light onto a target
thereby illuminating the target and adapted to
effect a reception of the back-scattered signal
from the target into the cladding of the
waveguide,
- b) an actuator capable of achieving large in-plane
displacement,
- 10 c) motion sensors capable of providing the necessary
signals for closed loop control of the scan
amplitude,
- d) a cladding mode detector capable of implementing a
confocal detection system so as to effect a
detection of the light backscattered into the
15 cladding of the waveguide,
- e) a lens, which may be formed in the wall of the
device package,

the device being coupled to a laser source, which may
be hybridised or integrally formed with the device of
20 the present invention or linked thereto by a section of
optical fibre so as to provide the incident light to
the waveguide.

24. The system as claimed in claim 23 wherein the elements
25 a)e) are all fabricated in silicon-based materials
using a compatible process.

25. A method of forming an optical reader comprising the
steps of:

- 30 a) forming a detector in a substrate,
b) forming an actuatable cantilever also in the
substrate,
c) coupling a waveguide to the cantilever, and

wherein the cantilever and detector are integrally
formed in the substrate, the waveguide being adapted to
transmit light onto a target and receive light
backscattered from the target, the light received back
5 into the waveguide being detectable using the detector.